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in one of the four fundamental processes does imply a roughly similar degree of excellence in the others. The correlation was not so high between the fundamentals and reasoning; still, when three cities are omitted which avowedly laid the main stress on the fundamentals, the correlation is moderately large.

On the second head—the relation of time expenditure to results—there is, on the whole, little or no correspondence, except in the case of the four processes where home study is figured in. By time expenditure is meant the time spent by the six lower grades in the years during which the pupils tested presumably had been passing through them. The results were computed with inclusion of study periods in school, and both with and without inclusion of home study.

While there are several sources of error in obtaining the above result, still the variations are too great to be accounted for by them. The school system at one extreme of the time-scale spent 7 per cent. of its time on arithmetic, the one at the other extreme, 22 per cent. The first-mentioned was third poorest, the second twelfth from the poorest out of twenty-six systems. *The two systems which made the best and the poorest showing spent respectively 14 and 12 per cent. of their total school time on arithmetic.*

The author attributes this lack of correspondence to a number of causes, among them, (1) wasting of time during the writing of the tests by unnecessarily long verbal analyses of the problems, and (2) wasting of time during the test by counting. These causes indicate defects in arithmetical instruction.

Other conclusions were (1) concentrating the arithmetic of the first six grades in the third to sixth grades produces at least no better results than distributing it over the six grades; (2) home study helps; (3) excellent courses of study are only an opportunity for excellent work. On the whole, it is a valuable investigation for principals and superintendents, not too technical for the beginner in statistical methods. Its chief aim is to standardize elementary-school arithmetic.

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School Algebra, Part II. By W. E. PATERSON. Oxford: The Clarendon Press, 1908. Pp. lxvii+604. 3s.

There is on the part of many teachers a feeling that the content of the course usually given in college algebra is in need of revision. From the point of view of the average student this course seems to consist of a miscellaneous collection of subjects which have vital relations neither with one another nor with anything else he has studied except, possibly, elementary algebra. The latest college algebras by American authors remedy this in part, but they seem to be written exclusively for students of pure mathematics. This algebra by Professor Paterson, however, comes quite close to meeting the needs of the technical schools, and covers the ground of the usual course in college algebra.

While the necessity of rigorous mathematical treatment seems to be kept in view, the formal proofs are not incomprehensible to the average student. If there is a lack of rigor in some cases, the simple, common-sense explanations carry conviction of the truth, and give the student a grasp of principles which he can use in solving problems. Most of the various algebraic operations and

processes are introduced in a way to show that they are necessary for the solution of practical problems. The lists of problems and applications contain many practical problems, and may be read with profit by American textbook writers.

The treatment of variation and of geometric progression is especially good. There is a good discussion of limiting values, followed by convergency and divergency of series. In some London University examinations a knowledge of French and German mathematical terms is required, hence a few problems in those languages are given. Why should not our college textbooks contain some problems in these languages? Forty-seven pages are given to examination papers of the universities of Oxford, Cambridge, and London, of the joint matriculation boards of universities, and so on; and it is interesting to note that nearly every paper contains one problem on the graph.

Plane and Solid Geometry. By ELMER A. LYMAN. New York: American Book Co., 1908. Pp. 340. \$1.25.

It was the purpose of the author "to prepare a geometry through which a student must work his way, relying on his reasoning powers rather than on his memory." The logical side has been emphasized throughout, and though there is no great departure from the beaten path, the changes made are along the lines upon which there has been general agreement in the recent discussions on the teaching of geometry.

The desire of many teachers to postpone or omit the discussion of incommensurable number and limits has received some consideration. However, the author or teacher who wishes to lighten the burden of the pupils at this point, should make it clear to them that this is done by omitting exact definitions and rigorous proofs. The definition, "A limit of a variable is a constant that the variable may approach and remain indefinitely near," is certainly not the best that could be given; and here as elsewhere it is left for the teacher to assure the pupils that the reasoning is not rigorous.

Historical notes are a welcome addition to any textbook, and those given here are well selected. They should be used by the teacher to arouse the interest of the pupils in the development of geometry. There is a good number of geometrical and numerical exercises. While some hints are given concerning accuracy and rapidity in computation, the subject deserves greater attention. There is a wide field for problems including principles of arithmetic, algebra, and geometry in which short methods of computation may be practiced, methods of checking results may be learned, and the limits of accuracy may be determined.

It would seem that the ideal textbook in geometry should include much drawing and construction, should demand that measurements be made by the pupils, and should keep alive the algebra of the preceding year.

A Scrap-Book of Elementary Mathematics. By WILLIAM F. WHITE. Chicago: The Open Court Publishing Co., 1908. Pp. 248. \$1.00.

This volume includes seventy essays, puzzles, and notes on interesting and curious mathematical problems. It is just what the name denotes, a scrap-book